NOAA Fisheries Service–National Sea Grant College Program

Fellowships in Population Dynamics and Marine Resource Economics

2006 Fellows Meeting

March 13-15, 2006
UCSD
Southwest Fisheries Science Center, La Jolla, CA

Monday, March 13

8:30 **Welcome**
Bill Fox, Director, Southwest Fisheries Science Center
Russ Moll, Director, California Sea Grant
Terry Smith, NMFS, National Sea Grant Office

9:00 – 12:00 **Fellows' seminars**, **Session I** (see seminar schedule)

12:00 – 12:30 pm **Lunch**

12:30– 2:00 pm **Fellowships 101**
Applying for a government job – Terry Smith
Fellowship 'nuts and bolts' – Jacques Oliver
NOAA Fisheries Service's research infrastructure – Bill Fox

2:00—2:15 **Break**

2:15 – 4:30 pm **Meet the scientists**
Population dynamics fellows meet with Population Dynamics staff from the SWFSC;
Resource economics fellows meet with Social Science staff;
Format - general discussion and Q&A

6:00 – 8:00 pm **Reception**
Martin Johnson House, UCSD

Tuesday, March 14

8:30 – 12:00 **Fellows' seminars, Session II** (see seminar schedule)

12:00 – 12:30 pm **Lunch**

12:30 – 2:00 **Informal discussions with faculty and staff**

2:00 – 4:30 pm **Panel Discussion**
The role of fisheries science in fisheries and fisheries management.
Ken Franke – M/V Outer Limits, San Diego
Jim Joseph – Director Emeritus, Inter-American Tropical Tuna Commission, San Diego
Dale Sweetnam - California Fish & Game, La Jolla
Pete Flournoy – Western Fishboat Owners Association, San Diego
Don Kent – Director, Hubbs-Sea World Research Institute

Wednesday, March 15 [optional]

8:30 – 11:30 am **Tour**
Hubbs-Sea World, Carlsbad, California, a white bass hatchery facility

The Fellowships

In 1999, NOAA National Sea Grant Office and NOAA Fisheries established a Graduate Fellowship Program in two specialized areas: population dynamics and marine resource economics. Population dynamics is the study of fish populations as affected by fishing mortality, growth, recruitment and natural mortality. Ph.D. candidates interested in the population dynamics of living marine resources and the development and implementation of quantitative methods for assessing their status can receive up to three years of funding. Ph.D. students in marine resource economics, concentrating on the conservation and management of living marine resources, can receive two years of funding.

The four main goals of the NOAA Fisheries/Sea Grant Fellowship Program are:

- *To encourage qualified applicants to pursue careers in either population dynamics and stock assessment or in marine resource economics*
- *To increase available expertise related to these fields*
- *To foster closer relationships between academic scientist and NOAA Fisheries*
- *To provide real-world experience to graduate students and accelerate their career development.*

Fellowships in Population Dynamics and Marine Resource Economics

2006 Fellows Meeting

SEMINAR SCHEDULE

Session I, Monday, March 13

9:00 – 9:20	Kathy Mills, Cornell University *Scale and power: interrelated considerations in the use of ecosystem indicators*
9:20—9:40	James Murphy, University of Washington *Snow crab population dynamics in the eastern Bering Sea*
9:40— 10:00	Michael Errigo, University of Maine *Structured errors in modeling fisheries population dynamics and stock assessment*
10:00—10:20	**Break**
10:20—10:40	Eric Ward, University of Washington *New methods for incorporating catastrophes in time series*
10:40—11-00	William Eldridge, University of Washington *An assessment of population viability of Chinook salmon in the Pacific northwest following anthropogenic selection on fitness*
11:00—11:20	Leif Anderson, University of Washington *The economic value of marine recreational fishing on the west coast*
11:20—11:40	Tina Willson, Louisiana State University *Investigating pre-harvest management alternatives for reducing the public health impacts of fish contamination*
11:40—12:00	Melissa Ann Haltuch, University of Washington *Life history, climate forcing, and fish stock assessment – evaluating statistical power*

Session II, Monday, March 14

8:40—9:00	Harrison Fell, University of Washington *Rights-based management and processors' supply: an application to the Alaska pollock fishery*
9:00—9:20	Joshua Wiersma, University of Rhode Island *Benefits and costs of cooperative research*
9:20—9:40	Joshua Abbott, University of California, Davis *Bycatch in the mixed species fisheries in the eastern Bering Sea: a summary of ongoing research*
9:40—10:00	**Break**
10:00—10:20	Beth Gardner, Cornell University *Sea temperature: the final frontier?*
10:20—10:40	John Brandon, University of Washington *A stock assessment of the Bering-Chuckchi-Beaufort Seas stock of bowhead whales using Bayesian model averaging*
10:40—11:00	Jamie Cournane, University of New Hampshire *A spatial model for the synthesis of different fisheries datasets: an example of New England groundfish resources*
11:00—11:20	**Break**
11:20—11:40	Sarah Glaser, University of California, Scripps Institute of Oceanography *A bioenergetics model of Albacore Tuna in the California current system*
11:40-12:00	Matthew Krachey, North Carolina State University *Metrics for ecosystem management*

Population Dynamics Fellows-Abstracts

A stock assessment of the Bering-Chukchi-Beaufort Seas stock of bowhead whales using Bayesian model averaging

John Brandon
School of Aquatic and Fishery Sciences
University of Washington

Bayesian estimation methods, employing the Sampling Importance Resampling algorithm, are used to fit an age- and sex-structured population model to available data on abundance and stage-proportions (i.e., calves/mature animals in the population) for the Bering-Chukchi-Beaufort Seas stock of bowhead whales (*Balaena mysticetus*). The analyses consider three alternative population modeling approaches and Bayes factors are calculated to compare model fits to the data. However, there is no evidence for selecting one model over another, and furthermore, the models considered in this study result in different posterior distributions for quantities of interest to management. Posterior model probabilities are therefore calculated and used as weights to construct Bayesian model-averaged posterior distributions for outputs shared among models to take this ambiguity into account. This study represents the first attempt to explicitly quantify model uncertainty when conducting a stock assessment of bowhead whales.

A spatial model for the synthesis of different fisheries datasets: An example of New England groundfish resources

Jamie Marie Cournane
University of New Hampshire

One central problem in data analysis is deciding how to combine disparate data sources in a statistically meaningful approach. Complicating this problem further, data collection methods from one study to the next may involve using different sampling techniques, time scales, and spatial resolutions. Increasingly, researchers study marine fish populations through the simultaneous processing of spatial and temporal information. Furthermore, the inclusion of data from different datasets across a geographic area may result in a more robust spatially explicit dataset. This research incorporates multiple fisheries datasets for the groundfish community of the Gulf of Maine and Georges Bank. The groundfish community comprises of commercially valuable fish species, among these: Atlantic cod, *Gadus morhua*, haddock, *Melanogrammus aeglefinus* and yellowtail flounder, *Limanda ferruginea*. The datasets consist of the National Marine Fisheries Service (NMFS) spring and fall bottom trawl surveys, the NMFS/Observer commercial fishery otter trawl dataset, the Massachusetts inshore bottom trawl survey, and the Maine and New Hampshire inshore bottom trawl survey. Their design characteristics include fisheries-independent or fisheries-dependent, random or targeted, seasonal or variable, and inshore and/or offshore components. From the fisheries datasets, fisheries scientists estimate population abundances, biomass, and structure with indices. One particular index is species richness: the total number of species within a given area and time period. The goal of this research is to combine the fisheries datasets on groundfish in a spatial model by using species richness. I will present the framework of the spatial model and some initial results.

An assessment of population viability of Chinook salmon in the Pacific Northwest following anthropogenic selection on fitness

William Eldridge
School of Aquatic and Fishery Sciences
University of Washington

The main objective of this study is to evaluate the effects of anthropogenic selection on harvest or supplementation in chinook salmon populations. Population viability in many populations of chinook in the Pacific Northwest is below that required for replacement. As a result, a large number of populations are protected under the US Endangered Species Act and many are supported by artificial propagation. Understanding how harvest and artificial propagation can change genetic variability and hence population viability and population dynamics, is important for improving management and avoiding the premature demise of salmon populations. The specific objectives of this project are first to develop a quantitative genetics model suitable for measuring selection effects on two or more fitness traits related to population viability in chinook salmon; second, to integrate the

Population Dynamics Fellows-Abstracts (cont).

quantitative genetics model with an age-structured demographic model for a chinook salmon population; and third, to compare a range of scenarios of selection in order to identify the genetic risks to population viability, dynamics and population size that are associated with management practices in a population subject to harvest or supportive breeding. Incorporating anthropomorphic selection into viability analysis will permit the evaluation of the risks associated with a range of management strategies implemented in order to recover endangered populations. This approach will identify those factors that are most likely to affect population viability and hence dynamics and will significantly facilitate informed decisions.

Structured errors in modeling fisheries population dynamics and stock assessment

Michael Errigo
University of Maine

Two types of structured errors affect results when modeling population dynamics and stock assessment of living marine resources: non-random variability in biological parameters (e.g. trends in the intrinsic population growth rate) and non-random variability in data used to infer resource condition (e.g. trends or changes in errors for total catch reported by commercial fishers). The former are structured "process" errors and the latter are structured "measurement" errors. These process errors complicate efforts to understand the dynamics of living marine resources, make predictions about status of fish populations, and provide management advice. The measurement errors violate the randomness assumption on errors associated with fisheries data, which are required by almost all fisheries stock assessment models. In my study I will use simulation analyses to understand how structured errors affect the results from models used in fisheries stock assessment and management. I will also develop data collection, modeling, and policy approaches that can reduce the uncertainty and risk caused by structured errors. Simulated systems will be based on the American lobster fishery, the Atlantic cod fishery, and the Atlantic herring fishery in the Gulf of Maine, which have different biological and industrial characteristics. Using realistic simulation analyses, I will evaluate the effects of structured process and measurement errors on the full range of events in natural resource assessment: choice of models, parameter estimation (including assumptions about inestimable parameters and assumptions about error terms), and choice of management policies (risk aversion, choice of management goals, economic discount factors, etc.).

Sea Temperature: The Final Frontier?

Beth Gardner
Cornell University

Water temperature is known to be related to sea turtle catch locations in longline fisheries. Thus, sea surface temperature (SST) is often used to predict suitable habitat, or to examine the probabilities of catching turtles. However, due to cloud coverage on daily images, multiple-day composites are often used for these analyses without regard to the daily variability of SST. Our study aims to quantify spatial and temporal patterns of loggerhead sea turtle distributions, to better understand the turtles' connection to SST along the Gulf Stream, and to improve management to minimize undesired interactions with the pelagic longline fishery. The data examined are from the NOAA fisheries pelagic observer program extending from 1992 to 2003 and the Naval Coastal Ocean Model (NCOM) sea surface temperatures (SST). NCOM provides continuous coverage daily SST. To quantify changes in sea surface temperatures spatially, we examined the daily SST from NCOM to estimate variability over 8-day and monthly time periods. Preliminary results indicate that in certain regions of the Western North Atlantic, SST can change by 5ºC within an 8-day period. This study emphasizes the need for higher resolution data to appropriately analyze loggerhead sea turtle distributions. A better understanding of loggerhead distributions in relation to oceanographic features may result in management decisions that reduce loggerhead interactions with pelagic fisheries.

Population Dynamics Fellows-Abstracts (cont).

A Bioenergetics Model of Albacore Tuna in the California Current System

Sarah M. Glaser
Scripps Institution of Oceanography
University of California San Diego

This study will describe the diet habits of North Pacific albacore (Thunnus alalunga) in the California Current System and will quantify the impacts of change in diet on albacore energetics and population dynamics. Albacore are seasonal visitors to the California Current System (CCS). From June to October, juvenile albacore migrate through the CCS from Baja, Mexico to southern Canada. While in coastal waters, they are fished by recreational and commercial troll vessels. Albacore are voracious, opportunistic top predators, and past diet studies show they consume pelagic fishes such as anchovy and saury, crustaceans such as euphausiids and pelagic crabs, and many species of squid. While it is believed albacore are not selective predators, definite patterns in diet habits are obvious and based on the spatial and temporal distributions of prey. For example, the prey field of albacore is significantly more speciose in the central CCS, a biogeographical transition zone, than in the northern or southern parts of the current. The nutritional quality of these prey (known as prey energy density or PED [$kJ \cdot gr^{-1}$]), also varies; for example, crustaceans have an average PED of 2.0 while small pelagic fishes have an average of 6.0. This variability may impact the amount of biomass albacore must consume, if changes in the nutritional prey field are enough to impact the bioenergetics of the albacore. On the other hand, it is also possible that the wide variety of prey species consumed means albacore experience a steady average PED field, and changes in relative abundances of prey at the species level will not change the total foraging effort of the albacore.

Given that many prey species undergo considerable population fluctuations, it is important to determine how changes in the prey field, with respect to the nutritional quality of that prey, will impact the energetic demands of albacore. This can be accomplished with a bioenergetics model that represents consumption by albacore as the sum of energetic requirements, where Consumption = (Active Metabolic Rate + Standard Metabolic Rate + Growth + Reproduction)/Assimilation Rate. Dividing total consumption by an ensemble PED (PED_N) calculates a daily consumption rate. The ultimate goal of this study is to quantify changes in albacore predation in response to simulated changes in PED_N, as the relative consumption of prey species changes. Albacore stomachs have been collected from the recreational and commercial fisheries; so far, 250 stomachs have been collected, and field sampling will continue during the fishing season 2006. Past diet studies will be compared to data collected from this study to determine whether diet habits of albacore have changed over the last four decades. Diet data will be used in the bioenergetics model to direct simulations. Here I present initial results from the bioenergetics model using diet data from an 1968 study. Furthermore, a standardized catch per unit effort time series is presented to show temporal and spatial variability of the albacore population in the CCS.

Life history, climate forcing, and fish stock assessment – evaluating statistical power

Melissa Ann Haltuch
School of Aquatic and Fishery Sciences
University of Washington

Inter-annual atmosphere-ocean climate variability in the Pacific, e.g. the Pacific Decadal Oscillation and the El Nino Southern Oscillation, has been well documented along with concurrent variability in both pelagic and demersal species. However, changes in population abundance of fish stocks are largely attributed to fishing impacts, rather than environmental variability. High variability around stock-recruitment curves indicate that climate, in addition to stock size, probably affects early life history survival and subsequent recruitment to fisheries. Thus, management advice that ignores inter-annual climate forcing of productivity and / or carrying capacity may cause stocks to be over- or under-harvested. The efficacy of including environmental impacts on recruitment in management models needs to be evaluated to take account of environmental considerations within the single-species stock assessment paradigm. Therefore, simulation testing is used to determine the statistical power of currently-used stock assessment methods to correctly identify whether climate is forcing either carrying capacity or stock productivity. Specifically, climate may impact productivity via the steepness of the stock-recruitment curve (h) or via the unfished average stock size. Simulation results provide guidance for including climate as a forcing function in single-species stock assessments for three generalized life history types: a short lived pelagic schooling species, a moderately long-lived flatfish, and a long-lived rockfish.

Population Dynamics Fellows-Abstracts (cont).

Metrics for Ecosytem Management

Matthew Krachey
Department of Statistics
North Carolina State University

The emphasis of fisheries management is moving towards minimizing the impacts on non-targeted species that co-exist with commercially valuable species, instead of managing simply to maximize harvest.

As fisheries agencies move towards ecosystem management, a standardized monitoring methodology will be necessary so that managers can compare spatial and/or temporal fluctuations in community composition. Specific metrics may seek to characterize aspects such as: presence-absence of a species, number of species, relative frequency of species, relative spatial concentration of a species, temporal changes in species composition, and species richness.

Simulations of multi-species environments can play a vital role in developing an understanding of the characteristics and robustness of potential ecosystem metrics. Here n-species Lotka-Volterra ecosystems were created from random parameter distributions. The impacts of simple fishing (affecting both targeted and nontargeted species) on the relative species abundances will be assessed. Directions for future research will also be discussed.

Scale and power: interrelated considerations in the use of ecosystem indicators

Kathy Mills
Cornell University

Incorporating ecological considerations into fishery management decisions is an emerging goal, and ecosystem indicators have been explored as a way to accomplish this task. Numerous potential indicators have been proposed to support ecosystem-based approaches to fisheries management. However, in many cases, detailed investigations of appropriate temporal and spatial scales at which indicators should be developed have not been conducted. In addition, the power of empirical indicators to convey a trend or change at time scales relevant to management decisions also is an important consideration when evaluating indicators that may be applied for management purposes. I will present examples of ecosystem indicators that have been developed from data collected by the Northeast Fisheries Science Center. Temporal and spatial patterns in each indicator will be presented to identify scales at which these indicators may be the most useful. The statistical power to detect trends in the empirical indicators will be discussed, and ideas of methodological approaches to enhance this power will be explored.

Snow crab population dynamics in the Eastern Bering Sea

James Murphy
University of Washington

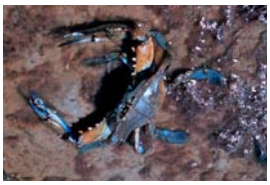
The snow crab (Chionecetes opilio) abundance in the Eastern Bering Sea (EBS) has declined sharply in the last two decades. Concurrent with the decline in abundance, snow crab distribution has constricted to the northern part of its range in the EBS. The snow crab fishery had its largest harvests in the early 1990s while recent harvests have been around 10 percent of the harvests in the 1990s. The causes for this decline in abundance and shift in distribution is not well understood. Analyzing snow crab population dynamics is complicated by the lack of detailed biological data regarding its growth, natural mortality, movement, and reproductive biology. A strong spatial gradient appears to exist in the snow crab's biology and ecology. To begin modeling the snow crab population dynamics in a spatially-structured framework, I have begun to estimate size-at-instar, size-at-maturity, and predation mortality. These results will be presented and future directions will be discussed.

Another research interest centers on the variability of the feeding ecology of walleye pollock and commercial groundfish species and how that variability may be included in multi-species virtual population analyses (MSVPA) for the EBS. A brief overview of this research focus will be discussed, also.

Population Dynamics Fellows-Abstracts (cont).

New Methods for Incorporating Catastrophes in Time Series

Eric Ward
University of Washington



Catastrophic events are considered a major contributor to extinction threats, yet rarely included in population viability analysis. We extend the basic state-space population dynamics model to include a mixture distribution for the process error component of the model. The mixture distribution consists of a "normal" component describing regular variability, and a "catastrophic" component. The catastrophic component represents rare events that negatively affect the population. Direct estimation of parameters is rarely possible using a single time series, however estimation is possible when multiple surveys are available, or time series are combined in a meta-analysis. We apply the catastrophic state-space model to simulated time series of abundance from simple non-linear population dynamics models. Applications of the model to these simulated time series indicate that population parameters, and observation and process errors are estimated robustly. Both the frequency and magnitude of catastrophes are susceptible to bias, which is a linear function of the true values of the parameters. Our simulations indicate that the power to detect a catastrophe is also a function of the magnitude of catastrophes, and the degree of observation and process error present. A model that contains a mixture of gamma process errors and gamma observation error is more robust to model misspecification than a model that contains lognormal observation errors.

We illustrate an application of a catastrophic state-space model, in which normal year to year process errors and infrequent catastrophic mortality events combine in a meta-analysis of pup production for three northern fur seal populations in the Bering Sea. We consider 24 candidate models, each of which allows the time series from each island to have unique population parameters. We also consider different forms of observation uncertainty, including survey-specific CVs, and an additive scaling parameter, to evaluate whether the standard error estimates of the surveys are underestimated. Using the deviance information criterion (DIC) the data supported two possible models, the first model, which was favored slightly, contained a single process error distribution, and the second model contained a process error mixture distribution that incorporated catastrophes. In the second model the estimated probability of a catastrophe for our three populations was found to be approximately 1.5%, and the most common catastrophic events were found to reduce the number of pups by only an additional 3%. To evaluate the power of this method to detect catastrophes, we generated a number of simulated data sets based on these values and found that the power to detect low-frequency low-magnitude catastrophes was quite small. Thus, it is likely that for many populations, catastrophes may not be detected even with systematic monitoring. These results underscore the importance of quantitative analyses to determine data needed to detect catastrophes of a given magnitude and to include estimates of probability of catastrophes in viability assessments.

Marine Resource Economics Fellows-Abstracts

Bycatch in the Mixed Species Fisheries of the Eastern Bering Sea: A Summary of Ongoing Research

Joshua Abbott
University of California, Davis

The bycatch of prohibited species (most notably halibut and certain crab species) in the fisheries of the Eastern Bering Sea (EBS) has been a major cause of ongoing concern for both fishermen and managers. This bycatch has frequently resulted in premature closures of fisheries by regulators in order to avoid exceeding these fisheries' apportionments of bycatch. The cost of these closures has been millions of dollars of foregone revenues. This presentation briefly outlines two approaches to studying this problem – one theoretical and (mostly) complete and the other empirical and ongoing.

In an attempt to understand the intersection between management institutions, incentives, and bycatch outcomes, we have devised a theoretical model that mimics the essential features of the Bering Sea fisheries. In this model, fishermen independently pursue the catch of target species to maximize their profits and can only avoid the bycatch of prohibited species at a significant and increasing cost. Quotas for both target and bycatch species (enforced by season limits) are held in common by all fishermen. The noncooperative Nash equilibria generated by this model deviate significantly, for all but the smallest of fisheries, from the rent maximizing cooperative solution. This outcome occurs because fishermen fail to internalize the external costs of their fishing behavior on the equilibrium season length due to the lack of exclusive property rights for the harvest of targeted and bycatch species. We then utilize the model to analyze the effects of various policy instruments and develop the optimum bycatch penalty to reconcile the economic

Marine Resource Economics Fellows–Abstracts (cont.)

optimum and noncooperative solutions. Interestingly, we find that the use of improved (lower bycatch) fishing gears has little potential for the lengthening of fishing seasons or increasing of rents. Managers must establish proper incentives in the fishery (perhaps in the form of IFQs or fishing cooperatives) in order to recognize the gains from improved fishing technology.

In the empirical portion of this research, we examine the actual behavior of fishermen under the common quota system by modeling one important determinant of bycatch outcomes – the decision of where to fish. To do this, we augment a traditional random utility model of fishing location choice with measures of expected bycatch as well as the usual measures of expected revenues and steaming costs. We utilize six years of spatially and temporally disaggregated vessel-level data from the North Pacific Groundfish Observer Program to specify the model. Although we are currently engaged in estimating the model, we will soon have estimates for the implicit shadow value of bycatch to fishermen and be able to conduct inference on its magnitude (which should be close to zero given the predictions of the theoretical model). Finally, we hope to assess the incentive effects of a voluntary bycatch avoidance system joined in by some fishermen by comparing the estimated shadow values before and after the program across a group of participating and non-participating fishermen.

The Economic Value of Marine Recreational Fishing on the West Coast

Leif Anderson
University of Washington

Saltwater sport fishing in Oregon and Washington is an important activity set in a rapidly changing environment. Fishery managers need up to date preference information to characterize potential regulatory changes. We seek to fulfill this need through a stated preference (SP) modeling approach, administered through a mail survey. Changes in catch, cost, and regulations in the fishery will be quantified and the welfare effects of possible management scenarios will be mapped onto our attributes and simulated. One of the important goals of this project is to identify the preferences of anglers with regard to catching and/or keeping wild and hatchery salmon. The distinction between hatchery and wild salmon made national headlines when recognized by the White House Council on Environmental Quality in a recent press release. Grouped salmon regulations make identification of these preferences difficult as binding catch limits allow a full array of sequential release strategies for individual anglers and this remains unobserved for the researcher. A subset of our experimental design will be used to uncover average preferences and latent class and mixed logit models will characterize the heterogeneity of group preferences likely to be present in the final dataset. Simulated choice data or the first wave of survey returns will illustrate our modeling approach.

Rights-Based Management and Processors' Supply: An Application to the Alaska Pollock Fishery

Harrison Fell
Department of Economics
University of Washington

Economists have generated numerous studies analyzing how a move to rights-based fishery management from open-access management affects fish harvesters' behavior. Conversely, the impacts that such a change in management can have on fish processors has received relatively little attention. This paper presents a simple two-product processor supply model to show that switching to a rights-based managed fishery can be a source of rent generation for the processors by making their supply more responsive to output prices. Using data from the Alaska pollock fishery, a cointegration with structural break analysis is used to provide evidence of a change in the long-run relationship between processors output, product prices, and whole fish deliveries. The empirical application finds that the endogenously determined structural breaks happened near the time this fishery implemented an individual fishing quota program. Furthermore, the estimation of the cointegrating vector indicates that the processors of this fishery are more price responsive after the change in management.

Marine Resource Economics Fellows-Abstracts (cont).

Benefits and Costs of Cooperative Research

Joshua Wiersma
Environmental and Natural Resource Economics
University of Rhode Island

Increased cooperative research activities in recent years have raised some important questions. For example, is the money spent on cooperative research a good investment? Are the benefits greater than the costs? Who benefits? What is the nature of the benefits? What is the nature of the costs? Only a few studies have surveyed a population of commercial fishermen to examine some of these questions (Wiersma 2004; NRC 2003, Harms and Sylvia 2000). Evidence from this research suggests that the total value of cooperative research programs to the commercial fishing, scientific and management communities may extend beyond that of the dollars paid to participants for their involvement. Therefore, the goal of this research is to determine the benefits and costs, economic impacts, and the total value of cooperative research in the northeast fisheries based on federally accepted guidelines for determining benefits and costs.

A measure of compensating surplus of the different, priority cooperative research projects in the northeast fisheries will be estimated based on certain utility of profit supply models. Net benefits for specific research areas will be calculated by comparing the total costs of each priority research area to the total benefits. Economic multipliers of cooperative research will be calculated specific to gear type, fishery, and fishing region based on the IMPLAN models developed at the Northeast Fisheries Science Center. Finally, an attempt to estimate of the total value of the northeast cooperative research program will be made. Policy makers need to know the relative benefits and costs of each alternative research projects, and the total value of the cooperative research program, in order to make decisions most consistent with societal welfare.

Investigating Pre-harvest Management Alternatives for Reducing the Public Health Impacts of Fish Contamination

Tina Willson
Center for Natural Resource Economics & Policy
Louisiana State University

The presence of harmful contaminants in fish is a growing public health concern, as evidenced by the increasing number of fish consumption advisories in the United States aimed at limiting the amount of contaminants that reach fish consumers. Consumer reaction to consumption advisories, however, is unpredictable. Being voluntary in nature, advisories typically miss their intended audiences, may be misconstrued to apply to non-target species, and may lead to resource waste if landed fish are discarded due to changes in consumer demand. At the current time, no pre-harvest methods are used to control the amount of contaminants that reach fish consumers. Given that many toxic chemicals bioaccumulate, fish contamination can vary significantly by size- and/or age class. This research aims to investigate the economic feasibility of more directed, size-based management of marine fisheries that explicitly accounts for the dynamics of optimal harvesting in the presence of contamination. An overview of seafood consumption and public health issues will be presented, highlighting why alternative approaches may be needed in order to reduce the public's long-term exposure beyond that achieved through voluntary responses to consumption advisories. Ongoing work to develop a theoretical model and its future application to mercury contamination in the South Atlantic and Gulf of Mexico king mackerel fishery will also be discussed.